The solar magnetic field and the solar wind: Existence of preferred longitudes

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Abstract. **Direct measurements of the solar wind speed and the radial component of the interplanetary magnetic field acquired over more than three solar cycles are used to search for signatures of a persistent dependence of solar wind properties on solar longitude. Two methods of analysis are used. One finds the rotation period that maximizes the amplitude of longitudinal variations of both interplanetary and near-Earth data mapped to the Sun. The other is based on power spectra of near-Earth and near-Venus data. The two methods give the same result. Preferred-longitude effects are found for a synodic solar rotation period of 27.03 ± 0.02 days. Such high precision is attained by using several hundred thousand hourly averages of the solar wind speed and magnetic field. The 27.03-day periodicity is dominant only over long periods of time; other periodicities are often more prominent for shorter intervals such as a single solar cycle or less. The 27.03-day signal is stronger and more consistent in the magnetic field than in the solar wind speed and is stronger for intervals of high and declining solar activity than for intervals of low or rising activity. On average, solar magnetic field lines in the ecliptic plane point outward on one side of the Sun and inward on the other, reversing direction approximately every 11 years while maintaining the same phase. The data are consistent with a model in which the solar magnetic dipole returns to the same longitude after each reversal.**